Using sonobuoys and visual surveys to describe North Atlantic right whale acoustic ecology in the Gulf of St. Lawrence

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Passive Acoustic Monitoring (PAM) is an established method to identify the presence of vocally-active North Atlantic right whales (NARW). The appropriate use and interpretation of PAM data relies on knowledge of the NARW sound repertoire and how it varies relative to variation in RW behaviour in time and space. Such information is difficult to obtain given the challenges of collecting acoustic and visual data simultaneously. Further, such relationships have not been quantified in the Gulf of St. Lawrence (GSL) NARW habitat, an area of considerable management importance given the NARW mortality events in 2017 and 2019. To assess possible acoustic and behavioural relations we deployed sonobuoys in the presence of three or more aggregated NARWs during aerial and vessel-based photo-ID surveys in 2017 (n=8), 2018 (n=25), and 2019 (n>=40). Acoustic data from each sonobuoy deployment were manually reviewed for all known NARW vocalizations, including upcalls, gunshots, and various other tonal sounds. The identified NARW vocalizations were then quantitatively compared to NARW behavioral-state variables derived from visual observations and individual NARW photo-ID data in the southern GSL. This information was then used to determine how much of the acoustic repertoire variation may describe NARW seasonal, behavioral, and demographic variation. These results will aid in the interpretation of NARW PAM in the GSL and can help inform effective management in this high-risk habitat.
Using Sonobuoys and Visual Surveys to Describe NARW Acoustic Ecology in GSL

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Introduction

- Detects NARW presence
- Equipment and biological variability

**PAM**

**Biological variability**
- Need both acoustic and visual info simultaneously

**Characterize biological variability**

- This study!
GOAL:
Characterize NARW acoustic repertoire and quantify how it varies with respect to demography, behaviour and time in the southern Gulf of St. Lawrence
Methods

Step 1. Visual data collection

Step 2. Acoustic data collection

Step 3. Data analysis
Step 1. Visual Data Collection

• NOAA aerial survey
• NEAq/CWI/Dal vessel survey via F/V Jean Denis Martin
• 3+ NARWs were seen
• Staying for >1 hr in the area
Step 2. Acoustic Data Collection

• Expired American and Canadian sonobuoys
  • sonobuoy contains a hydrophone and radio transmitter & transmit oceanographic sounds to a near by receiving platform
• Deployed ~0.5 to 1 km away from sighted whales
• Up to 8 hrs of recording time
  • Most were ~4 hours
The Big Picture!

Sonobuoy
Step 3. Data Analysis - Acoustic
### Number of Sonobuoys Deployed

<table>
<thead>
<tr>
<th>Year</th>
<th>NOAA Plane</th>
<th>F/V Jean Denis Martin</th>
</tr>
</thead>
<tbody>
<tr>
<td>2017</td>
<td>7</td>
<td>0</td>
</tr>
<tr>
<td>2018</td>
<td>11</td>
<td>12</td>
</tr>
<tr>
<td>2019</td>
<td>23</td>
<td>25</td>
</tr>
</tbody>
</table>

The red box indicates the deployments that I have completed that audio recordings for. The following slides are preliminary results from these recordings.
2017 and 2018 Aerial Survey Sonobuoy Deployments

Preliminary Result
Preliminary Result

Sightings within 15 km plus an hour before and after recording

Age Class, Sex
- Adult, Female
- Juvenile, Female
- Adult, Male
- Juvenile, Male

Calls detected

Call Type:
- Gunshot
- Mid-frequency
- Up Call
Preliminary Result

Sightings within 15 km plus an hour before and after recording

Calls detected

Call Type:
- Gunshot
- Mid-frequency
- Up Call
Up Calls

- Beginning of August: double males (22) than females (12)
- June: triple males (14) than females (5)
- End of July: 5 adult males, 3 adult females, 3 juvenile males, 1 juvenile female

Mostly the number of adult female and male is the same, very few juveniles

Preliminary Result
Mid-frequency Calls

Beginning of August; → double adult males (22) than females (12)

End of July; double adult males (12) than adult females (5)

← Mid July; 5 adult male, 4 adult female, 3 juvenile male, 1 juvenile female

Preliminary Result
Gunshot Calls

Preliminary Result

- Beginning of August; double adult males (22) than females (12)
- End of July; double adult males (12) than adult females (5)
- End of July; double adult males (7) than adult females (3)

Year
- 2017
- 2018

Number of NARW Sighted vs. Calls per Hour
Conclusions, so far

• Sightings ≠ number of calls

• The larger the difference between number of males and females seen the more mid-frequency and gunshot calls appear
  • Male to Female ratio, is it important...?

• Next steps:
  • Completing the remaining datasets
  • Including behaviours to analysis
  • Generalized linear models

• In completion of this project, the results may help interpret and further advance PAM to be more than presence only tool
Acknowledgements

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• NOAA aerial survey crew